US006246868B1

(12) **United States Patent**
Bullock et al.

(10) **Patent No.: US 6,246,868 B1**
(45) **Date of Patent: Jun. 12, 2001**

(54) **CONVERSION AND DISTRIBUTION OF INCOMING WIRELESS TELEPHONE SIGNALS USING THE POWER LINE**

(75) Inventors: **Scott R. Bullock**, South Jordan; **John M. Knab**, Sandy, both of UT (US)

(73) Assignee: **Phonex Corporation**, Midvale, UT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/134,468**

(22) Filed: **Aug. 14, 1998**

(51) **Int. Cl.**[7] **H04M 9/00**
(52) **U.S. Cl.** **455/402**; 455/14; 455/572
(58) **Field of Search** 455/13.4, 14, 402, 455/572

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,510,273	6/1950	Barstow et al. .	
2,516,211	7/1950	Hochgraf	179/3.5
2,516,763	7/1950	Edson et al.	179/2.5
2,535,446	12/1950	Mitchell	179/2.5
2,567,908	9/1951	Levy	177/356
2,577,731	12/1951	Berger	179/2.5
2,654,805	10/1953	Deer	179/2.5
2,820,097	1/1958	Finlay	179/2.5
2,828,363	3/1958	Ray	179/2.5
2,932,794	4/1960	Crow	328/156
3,045,066	7/1962	Beuscher	179/2.5
3,280,259	10/1966	Cotter	179/2.5
3,334,185	8/1967	Marlot	179/2.5
3,369,078	2/1968	Stradley	179/2.5
3,399,397	8/1968	Josephson	340/216
3,400,221	9/1968	Wolters	179/2.5
3,475,561	10/1969	Krasin et al.	179/15
3,521,267	7/1970	Lester et al.	340/310
3,529,216	9/1970	Kolm et al.	317/147
3,659,280	4/1972	Donohoo	340/310
3,693,155	9/1972	Crafton et al.	340/147 R
3,810,096	5/1974	Kabat et al.	340/147 R
3,818,481	6/1974	Dorfman et al.	340/310 R
3,846,638	11/1974	Wetherell	307/3
3,852,740	12/1974	Haymes	340/416
3,876,984	4/1975	Chertok	340/152 R
3,911,415	10/1975	Whyte	340/310 A
3,922,664	11/1975	Wadsworth	340/276
3,924,223	12/1975	Whyte et al.	340/310 R
3,925,728	12/1975	Whyte	324/142
3,925,763	12/1975	Wadhwani et al.	340/164 R
3,942,168	3/1976	Whyte	340/310 R
3,949,172	4/1976	Brown et al.	179/2.5 R
3,967,264	6/1976	Whyte et al.	340/310 A
3,973,087	8/1976	Fong	179/170 R
3,980,954	9/1976	Whyte	325/48
4,012,733	3/1977	Whyte	340/310 A

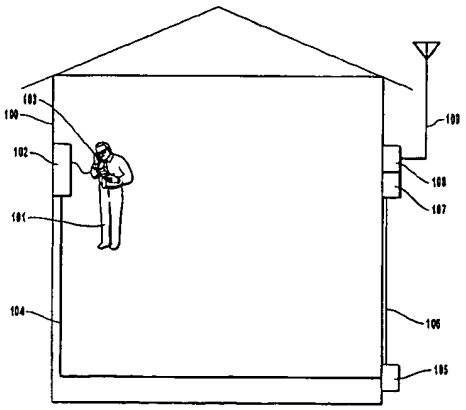
(List continued on next page.)

Primary Examiner—Daniel Hunter
Assistant Examiner—Thuan T. Nguyen
(74) *Attorney, Agent, or Firm*—Lloyd W. Sadler

(57) **ABSTRACT**

A method and system for the reception, conversion and distribution of wireless signals over AC power lines to one or more telephone communication devices within a building, office or complex is disclosed. This invention specifically provides for the reception of PCS, cellular and/or satellite communication signals, by receiving the wireless signal and providing an interface to standard generally available telephone equipment. By making use of the power line carrier channel, this invention provides for the reception of the wireless signals upon telephone equipment that is located in the building or complex in locations remote from standard telephone wiring. Moreover, by distributing such received wireless signals over the power line a number of telephone devices can be used to receive the distributed signals. This invention allows existing, or previously installed, telephones to communicate over and with wireless communication devices and provides a way to distribute these signals using power line telephone distribution methods, without requiring a change in existing wired telephone equipment.

13 Claims, 2 Drawing Sheets



U.S. PATENT DOCUMENTS

4,012,734	3/1977	Jagoda et al.	340/310 A
4,016,429	4/1977	Vercellotti et al.	307/149
4,057,793	11/1977	Johnson et al.	340/310 R
4,058,678	11/1977	Dunn et al.	179/2.5 R
4,065,763	12/1977	Whyte et al.	340/310 R
4,107,656	8/1978	Farnsworth	340/151
4,161,027	7/1979	Russell	364/492
4,173,754	11/1979	Feiker	340/310 R
4,174,517	11/1979	Mandel	340/310 A
4,218,655	8/1980	Johnston et al.	455/39
4,222,035	9/1980	Lohoff	340/167 R
4,239,940	12/1980	Dorfman	179/2.51
4,254,403	3/1981	Perez-Cavero et al.	340/310 R
4,307,380	12/1981	Gander	340/310 R
4,321,581	3/1982	Tappeiner et al.	340/310 R
4,323,882	4/1982	Gajjar	340/310 R
4,344,066	8/1982	Beggs	340/310 A
4,357,598	11/1982	Melvin, Jr.	340/310 A
4,371,867	2/1983	Gander	340/310 R
4,377,804	3/1983	Suzuki	340/310 A
4,386,436	5/1983	Kocher et al.	455/151
4,400,688	8/1983	Johnston et al.	340/310 R
4,408,185	10/1983	Rasmussen	340/310 A
4,408,186	10/1983	Howell	340/310 A
4,429,299	1/1984	Kabat et al.	340/310 R
4,433,326	2/1984	Howell	340/310 A
4,442,319	4/1984	Treidl	179/2 A
4,471,399	9/1984	Udren	361/64
4,473,817	9/1984	Perkins	340/310 R
4,475,193	10/1984	Brown	370/124
4,479,033	10/1984	Brown et al.	179/2.51
4,495,386	1/1985	Brown et al.	179/2.51
4,514,594	4/1985	Brown et al.	179/2.51
4,523,307	6/1985	Brown et al.	370/30
4,535,447	8/1985	Rosanes et al.	370/77
4,538,136	8/1985	Drabing	340/310 R
4,556,864	12/1985	Roy	340/310 A
4,556,865	12/1985	Fukagawa et al.	340/310 R
4,556,866	12/1985	Gorecki	340/310 A
4,559,520	12/1985	Johnston	340/310 R
4,599,598	7/1986	Komoda et al.	340/310 A
4,609,839	9/1986	Howell	307/542
4,611,274	9/1986	Machino et al.	364/200
4,633,218	12/1986	Palsgrove et al.	340/310 A
4,638,298	1/1987	Spiro	340/827
4,638,299	1/1987	Campbell	340/310 A
4,641,126	2/1987	Crowe	340/310 A
4,641,322	2/1987	Hasegawa	375/1
4,642,607	2/1987	Strom et al.	340/310 A
4,644,321	2/1987	Kennon	340/310 A
4,675,648	6/1987	Roth et al.	340/310 A
4,701,945	10/1987	Pedigo	379/66
4,745,391	5/1988	Gajjar	340/310 A
4,745,392	5/1988	Ise et al.	340/310 R
4,746,897	5/1988	Shuey	340/310 R
4,749,992	6/1988	Fitzemeyer et al.	340/870.02
4,759,016	7/1988	Otsuka	370/95
4,763,103	8/1988	Galula et al.	340/310 R
4,772,870	9/1988	Reyes	340/310 R
4,774,493	9/1988	Rabinowitz	340/310 A
4,783,780	11/1988	Alexis	370/95
4,788,527	11/1988	Johansson	340/310 A
4,809,296	2/1989	Braun et al.	375/1
4,829,570	5/1989	Schotz	381/3
4,835,517	5/1989	van der Gracht et al.	340/310 A
4,845,466	7/1989	Hariton et al.	340/310 R
4,847,903	7/1989	Schotz	381/3
4,864,589	9/1989	Endo	375/1
4,866,733	9/1989	Morishita	375/1
4,890,089	12/1989	Shuey	340/310 A
4,912,553	3/1990	Pal et al.	358/86
4,962,496	10/1990	Vercellotti et al.	370/11
4,963,853	10/1990	Mak	340/310 A
4,968,970	11/1990	LaPorte	340/310 A
4,988,972	1/1991	Takagi	340/310 A
4,995,053	2/1991	Simpson et al.	375/1
5,003,457	3/1991	Ikei et al.	364/133
5,032,833	7/1991	Laport	340/825.02
5,049,876	9/1991	Kahle et al.	340/825.57
5,063,563	11/1991	Ikeda et al.	370/110.1
5,065,133	11/1991	Howard	340/310 A
5,066,939	11/1991	Mansfield, Jr.	340/310 R
5,068,890 *	11/1991	Nilssen	455/402
5,136,612	8/1992	Bi	375/1
5,151,838	9/1992	Dockery	340/310 R
5,155,466	10/1992	Go	340/310 R
5,168,510	12/1992	Hill	375/40
5,187,865	2/1993	Dolin, Jr.	29/868
5,192,231	3/1993	Dolin, Jr.	439/620
5,210,518	5/1993	Graham et al.	340/310 R
5,241,283	8/1993	Sutterlin	330/51
5,257,006	10/1993	Graham et al.	340/310 A
5,262,755	11/1993	Mak et al.	340/310 R
5,278,862	1/1994	Vander Mey	375/1
5,289,476	2/1994	Johnson et al.	371/37.1
5,319,634 *	6/1994	Bartholomew et al.	455/402
5,327,230	7/1994	Dockery	348/8
5,349,644	9/1994	Massey et al.	395/200
5,351,272	9/1994	Abraham	375/38
5,355,114	10/1994	Sutterlin et al.	340/310 A
5,357,541	10/1994	Cowart	375/1
5,404,127	4/1995	Lee et al.	340/310.02
5,406,248	4/1995	Le Van Suu	340/310.01
5,406,249	4/1995	Pettus	340/310.06
5,410,292	4/1995	Le Van Suu	340/310.06
5,412,369	5/1995	Kirchner	340/310.03
5,424,709	6/1995	Tal	340/310.01
5,448,593	9/1995	Hill	375/267
5,452,344	9/1995	Larson	379/107
5,461,629	10/1995	Sutterlin et al.	371/30
5,463,662	10/1995	Sutterlin et al.	375/351
5,467,011	11/1995	Hunt	324/67
5,471,190	11/1995	Zimmermann	340/310.01
5,504,454	4/1996	Daggett et al.	329/304
5,554,968	9/1996	Lee	340/310.01
5,559,377	9/1996	Abraham	307/104
5,630,204	5/1997	Hylton et al.	455/3.3
5,634,191 *	5/1997	Beasley	455/14
5,787,336 *	7/1998	Hirschfield et al.	455/13.4
5,832,364 *	11/1998	Gustafon	455/402
5,930,684 *	7/1999	Keskitalo et al.	455/13.4

* cited by examiner

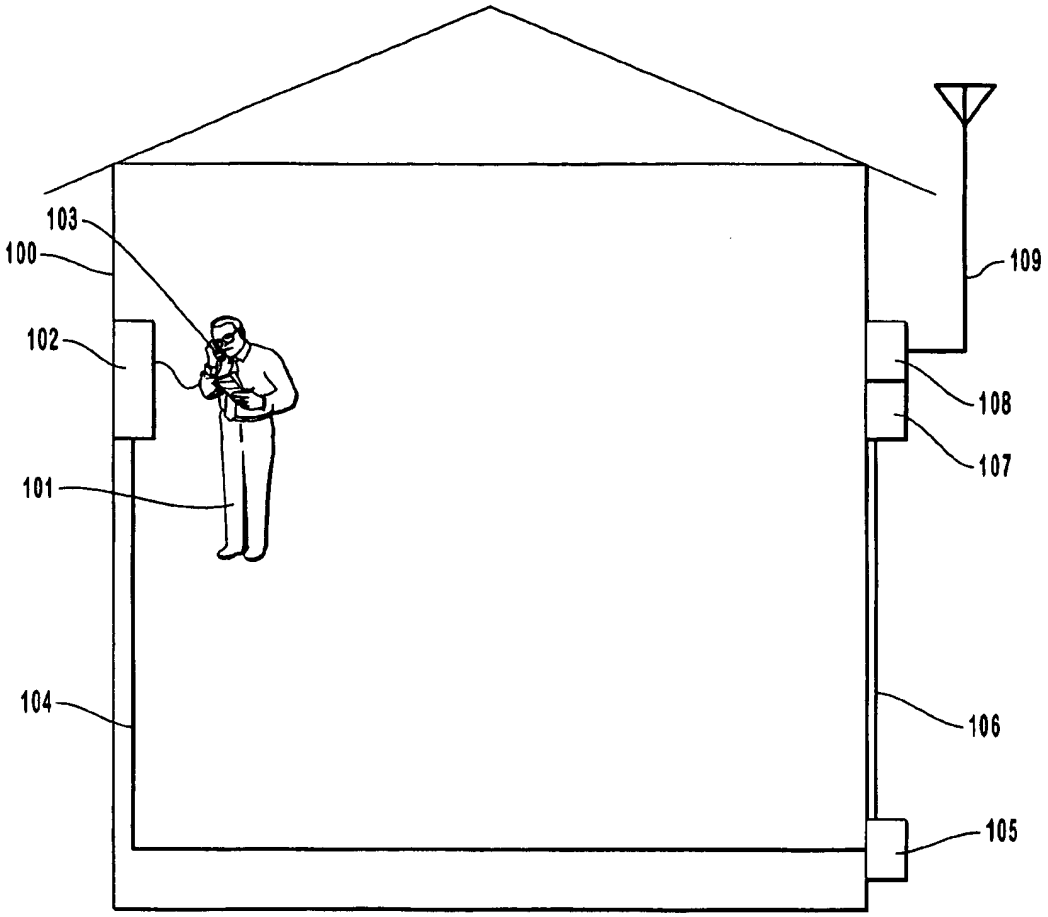


FIG. 1

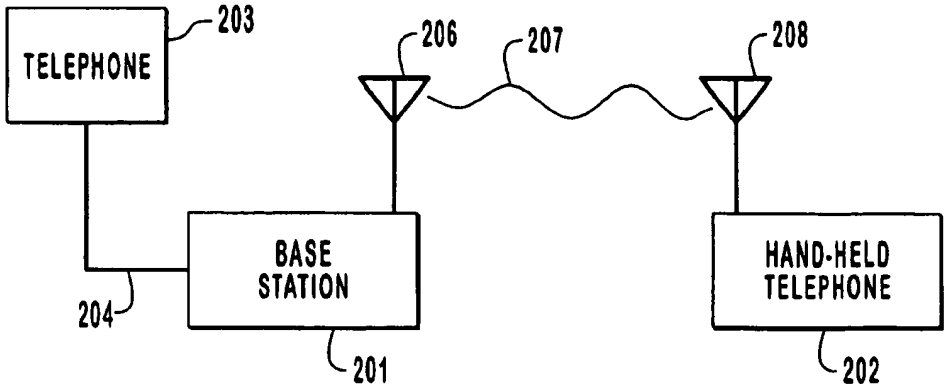

TELEPHONE
203
206
207
208
BASE STATION
HAND-HELD TELEPHONE
204
201
202

FIG. 2

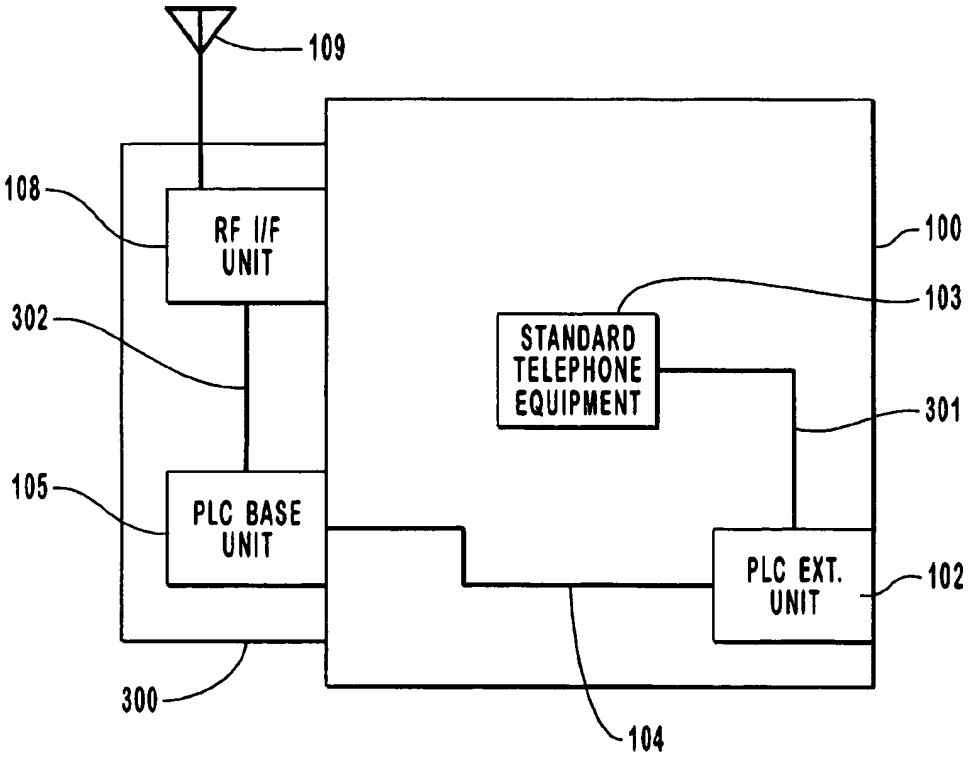

109
108
RF I/F UNIT
100
103
302
STANDARD TELEPHONE EQUIPMENT
301
105
PLC BASE UNIT
PLC EXT. UNIT
102
300
104

FIG. 3

CONVERSION AND DISTRIBUTION OF INCOMING WIRELESS TELEPHONE SIGNALS USING THE POWER LINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to wireless telephone communications equipment. More specifically, this invention relates to equipment for receiving, converting and distributing wireless radio frequency signals using AC power line distribution channels.

2. Description of Related Art

A variety of power line carrier telephone voice and/or data communication systems have been developed and are used to facilitate telephonic communications in locations where little or no availability exists for dedicated telephone wires. While these devices provide a connection to the existing power lines they do not provide a means of distributing communication systems using standard "wired" telephone communication equipment and AC power line signal distribution. Such communication systems include: personal communication systems ("PCS's"); cellular telephone; and satellite telephone systems. The reader is directed to the following United States and foreign patent documents for background on power line communication systems: 2,510,273, 2,516,211, 2,516,763, 2,535,446, 2,567,908, 2,577,731, 2,654,805, 2,820,097, 2,828,363, 2,932,794, 3,045,066, 3,280,259, 3,334,185, 3,369,078, 3,399,397, 3,400,221, 3,475,561, 3,521,267, 3,529,216, 3,659,280, 3,693,155, 3,810,096, 3,818,481, 3,846,638, 3,852,740, 3,876,984, 3,911,415, 3,922,664, 3,924,223, 3,925,763, 3,925,728, 3,942,168, 3,949,172, 3,967,264, 3,973,087, 3,980,954, 4,012,733, 4,012,734, 4,016,429, 4,057,793, 4,058,678, 4,065,763, 4,107,656, 4,161,027, 4,173,754, 4,174,517, 4,218,655, 4,222,035, 4,239,940, 4,254,403, 4,307,380, 4,321,581, 4,323,882, 4,344,066, 4,357,598, 4,371,867, 4,377,804, 4,386,436, 4,400,688, 4,408,185, 4,408,186, 4,429,299, 4,433,326, 4,442,319, 4,471,399, 4,473,817, 4,475,193, 4,479,033, 4,495,386, 4,514,594, 4,523,307, 4,535,447, 4,538,136, 4,556,864, 4,556,865, 4,556,866, 4,559,520, 4,599,598, 4,609,839, 4,611,274, 4,633,218, 4,638,298, 4,638,299, 4,641,126, 4,641,322, 4,642,607, 4,644,321, 4,675,648, 4,701,945, 4,745,391, 4,745,392, 4,746,897, 4,749,992, 4,759,016, 4,763,103, 4,772,870, 4,774,493, 4,783,780, 4,788,527, 4,809,296, 4,829,570, 4,835,517, 4,845,466, 4,847,903, 4,864,589, 4,866,733, 4,890,089, 4,912,553, 4,962,496, 4,963,853, 4,968,970, 4,988,972, 4,995,053, 5,003,457, 5,032,833, 5,049,876, 5,063,563, 5,065,133, 5,066,939, 5,136,612, 5,151,838, 5,155,466, 5,168,510, 5,187,865, 5,192,231, 5,210,518, 5,241,283, 5,257,006, 5,262,755, 5,274,699, 5,278,862, 5,289,476, 5,319,634, 5,327,230, 5,349,644, 5,351,272, 5,355,114, 5,357,541, 5,404,127, 5,406,248, 5,406,249, 5,410,292, 5,412,369, 5,424,709, 5,448,593, 5,452,344, 5,461,629, 5,463,662, 5,467,011, 5,471,190, 5,504,454, 5,530,737, 5,530,741, 5,550,905, 5,554,968, 5,559,377, 5,630,204, GB 544,243, GB 549,948, GB 553,225, GB 683,265, GB 1,393,424, GB 2,094,598, AU-B1-12,488/76, Canada 1057436, Canada 1216689, EPO 0 078 171 A2, EPO 0 555 869 A2, PCT/US83/01717, PCTIUS90/02291, PCT/US90/06701, PCT/US92/08510, PCT/US93/04726, PCT/US94/031 10, and PCT/US95/00354 each of which is hereby incorporated by reference in its entirety for the material disclosed therein.

SUMMARY OF THE INVENTORY

It is desirable to provide a method, system and devices which enable the use of AC power line communication for the distribution of signals from a wide variety of communication sources and which is adapted to provide a seamless interface with standard telephone equipment.

Therefore, it is the general object of this invention to provide an interface between wireless communication devices, power line signal distribution, and standard telephone subscriber equipment.

It is a further object of this invention to provide a power line communication interface that is adapted to send and receive signals to and from personal communication systems ("PCS's").

It is a still further object of this invention to provide a power line communication interface that is adapted to send and receive signals to and from cellular telephone devices.

It is another object of this invention to provide a power line communication interface that is adapted to send and receive signals to and from satellite communication devices.

It is a further object of this invention to provide a power line communication interface that is adapted to cooperate with standard wired telephone communication systems as are commonly installed for residential, business and government users.

It is still another object of this invention to provide a power line communication interface that has a base station for communicating with the standard telephone lines and with a remote telephone unit, using standard AC power lines as the communication channel.

A further object of this invention is to provide a power line communication interface that uses spread spectrum modulation techniques to communicate between the various communication devices.

Another object of this invention is to provide a system for integrating wireless communication equipment with existing typical wired telephone equipment, thereby permitting the user to take advantage of new and evolving personal communication systems while continuing to use existing wired telephone equipment.

These and other objectives of this invention further described in this disclosure and are readily apparent to those of ordinary skill in the art upon review of the following drawings, detailed description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representative drawing of a top level communication system using this invention.

FIG. 2 depicts the standard PCS telephone communication system.

FIG. 3 depicts the preferred components and connections used in the distribution of wireless communication signals to standard telephone equipment in this invention.

DETAILED DESCRIPTION OF THE INVENTION

This invention is a method and system for converting wireless communication signals and distributing such signals over established and/or standard telephone communication equipment. In essence, this invention is an interface that connects such communication devices as personal communication systems (PCS); cellular telephones, and satellite systems to typical wired telephone systems. In its preferred embodiment this invention comprises a base unit, a receiver, and an external conversion module which in combination with standard AC power line carrier lines and standard telephone equipment serves to permit existing telephones to

use various wireless telephone signals and simultaneously provides a way to distribute these wireless telephone signals to standard telephone equipment using power line telephone distribution methods.

FIG. **1** shows a top level representative drawing of a communication system employing this invention. The receiver **108** is mounted, typically on the outside, on the building **100**, preferably near a power line distribution box **105**. This receiver **108** is also connected to an antenna **109**, which in turn is adapted to send and receive communication signals. Moreover, this receiver **108** is designed to receive standard wireless signals. Once a wireless signal is detected, it is converted to a signal appropriate to being coupled to the base unit (or power line transmitter) **107**. The base unit **107** is typically embedded into the receiver **108** box or enclosure. The base unit **107** imposes the converted signal on the power line **104** via the power line distribution box **105**. Also connected to the power line **104** are one or more extension units **102**. Typically these extension units **102** are connected to the power line **104** by plugging each of them into a standard AC wall outlet. The extension unit **102** receives the power line signal which is transmitted from the base unit **107**, processes the signal, converting the signal to be compatible with the standard and or existing subscriber telephone equipment **103**, for use by the communication system user **101**. The preferred receiver box **108** using the technology of the wireless provider, which typically is embedded into the receiver box **108** for despreading and demodulation of the RF signal transmission. The reader should note that although the description above focuses on receiving a signal from the receiver box **108** to the extension unit **102**, the reverse signal transmission path is simultaneously supported, that is sending a signal from the extension unit **102** to the receiver box **108** for transmission.

FIG. **2** shows the typical or standard PCS telephone communication system. A base station **201** is provided to receive the signal from the telephone **203** via the phone lines **204** and to then send out a spread spectrum signal **207** across the airwaves via an antenna **206**. The transmitted spread spectrum signal **207** is received by a hand held telephone **202** having its own antenna **208**. The preferred hand held telephone **202** is specifically designed to receive and demodulate the spread spectrum signals and thereby retrieve the audio signal. Several well established techniques have been developed for the spread spectrum signaling for the above described data line, including Direct Sequence (DS), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA). The modulation frequencies are to perform in the ISM bands that have been allocated by the FCC for use with spread spectrum systems. The typical hand held telephone **202** is selected by the user **101**. Alternatively, a pre-existing telephone system, such as is commonly used with business communication systems and/pr apartment complexes, is incorporated with the PCS system described above.

FIG. **3** shows the preferred embodiment of invention depicting the components and connections used in the distribution of wireless communication signals to standard telephone equipment in this invention. An external conversion module **300** interfaces directly to the RF signals received from the antenna **109** to convert the incoming signals to the standard telephone signals. The RF signals, including PCS, Cellular and Satellite signals, enter the invention via the external antenna **109** on the external conversion module **300**. The preferred external conversion module **300** comprises an RF Interface unit **108** and a Power Line Carrier (PLC) base unit **105** to interface and both send and receive signals via the power line **104**. These power line signals are received (or sent) by the extension unit **102** via the telephone lines **301** which interface directly to the existing or standard telephone equipment **103**. This provides system provides the capability of using and distributing the existing telephone equipment with the wireless RF incoming signals, thereby providing the user with the ability to receive PCS signals anywhere in the building **100** where power outlets are available.

The described embodiment of this invention is to be considered in all respects only as illustrative and not as restrictive. Although, this embodiment of the invention describes voice telephone equipment, it alternatively can also be applied to electronic (computer modem) communication. Also, although this described embodiment of the invention identifies the use of certain well known modulation techniques, it is not intended to be limited thereto. Rather, this invention may alternatively employ other similar, currently known or developed in the future, modulation techniques. Similarly, this invention is not limited to specific components, and the substitution of alternative equivalent components should be considered within the scope of this invention. The scope of this invention is indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

We claim:

1. A system for the conversion and distribution of wireless telephone signals comprising:

(A) an external conversion module, adapted to receive RF signals, convert (TN) said received RF signals for power line communications, interface with a power line, receive communication signals from the power line, convert said received communication signals for RF (over-the-air) communications and transmits such RF signals, said external conversion module further comprising: an RF receiver, receiving RF signals, wherein said RF signals include personal communication system signals, cellular telephone signals and satellite signals; and

a power line base unit, providing an interface between said RF receiver and an AC power line communication channel, electrically connected to said RF receiver;

(B) an AC power line electrically connected to said power line base unit;

(C) a power line extension unit, for receiving signals transmitted by said power line transmitter, electrically connected to said AC power line; and

(D) a telephone communication device electrically connected to said power line extension unit for use by a telephone user in communicating information with another telephone user.

2. A system for the conversion and distribution of wireless telephone signals, as recited in claim **1**, wherein said power line base unit further comprises a spread spectrum modulator.

3. A system for the conversion and distribution of wireless telephone signals, as recited in claim **2**, wherein said spread spectrum modulation is selected from the group consisting of direct sequence, code division multiple access, time division multiple access, and frequency division multiple access.

4. A system for the conversion and distribution of wireless telephone signals, as recited in claim **2**, wherein said spread spectrum modulation is adapted to operate in the ISM bands.

5. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said power line is a standard 110 v AC power line.

6. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said power line is a standard 220 v AC power line.

7. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said extension unit connects to said AC power line using a standard AC wall plug.

8. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said extension unit further comprises a demodulator.

9. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said extension unit further comprises a receiver.

10. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said telephone communication device further comprises a microphone.

11. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said telephone communication device further comprises a speaker.

12. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, wherein said telephone communication device further comprises a means for inputting the telephone number to be called.

13. A system for the conversion and distribution of wireless telephone signals, as recited in claim 1, further comprising an antenna for receiving a wireless signal, wherein said antenna is electrically connected to said RF receiver.

* * * * *